SCIENTIFIC PAPER JSLS

A Ten-year, Single Institution Experience With Laparoscopic Splenectomy

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ABSTRACT

Background and Objectives: Laparoscopic splenectomy (LS) is now widely performed and is considered the standard of care for the treatment of certain diseases of the spleen. Although multiple studies have documented the safety and feasibility of laparoscopic splenectomy, little long-term data are available. We present a 10-year, single institution experience with laparoscopic splenectomy to determine trends in procedural outcome data.

Methods: Laparoscopic splenectomy was performed in 109 consecutive, unselected patients with benign or malignant hematological diseases from March 1992 to November 2001. A prospective, longitudinal database, medical record review, and patient interviews were used for data acquisition. During the last 10-years, the annual number of laparoscopic splenectomy was relatively constant. Therefore, patients were divided into 2 cohorts, comparing the first 55 consecutive patients (Group I) with the subsequent 54 patients (Group II) who underwent LS. Data were analyzed using the unpaired Student *t* test, with values of $P<0.05$ considered significant.

Results: Mean patient age was 39 years (range, 6 to 79) in Group I and 45 years (range, 13 to 77) in Group II. Total operative time was 151 minutes in Group I and 159 minutes in Group II (NS), estimated blood loss averaged 544 mm in Group I and 308mm in Group II ($P=0.015$). The mean specimen weight of the spleen was 288 g in Group I and 512 g in Group II ($P=0.03$). Morbidity occurred in 7 of the first 55 patients (13%) and 5 of the next 54 patients (9%). Additionally, 7 conversions to an open operation were necessary in Group I (13%) versus only 1 conversion in Group II (2%).

Conclusion: A decade of experience with LS shows that it can be performed safely for a wide variety of indications. Over the last 10 years, the average spleen size has increased, yet a significant reduction in blood loss and conversion rate has been achieved.

Key Words: Spleen, Laparoscopic splenectomy.

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INTRODUCTION

Since Quittenbaum performed the first splenectomy in 1826, splenectomy has been performed for a variety of hematological conditions.[1] However, few changes in the operative technique of splenectomy occurred until 1991, when Delaitre and Maignien[2] described their initial success with laparoscopic splenectomy. Over the last decade, laparoscopic splenectomy (LS) has grown from novelty to the surgical procedure of choice for many diseases affecting the spleen. The response rates of hematologic diseases to LS are similar to those of historical controls who underwent open splenectomy.[3,4] Compared with open splenectomy, however, LS is associated with decreased intraoperative blood loss, less postoperative pain, and a shorter hospital stay.[5–7]

The first laparoscopic splenectomy at the University of Maryland was performed in early 1992, shortly after Delaitre and Maignien's initial report. Little long-term perioperative data are available for LS, because few institutions have performed the procedure for more than a few years. We examined the 10-year, single-institution experience with LS at a university teaching hospital to determine trends in the operative technique, patient outcome, and indications for laparoscopic splenectomy.

MATERIALS AND METHODS

Laparoscopic splenectomy has been performed at the University of Maryland since March 1992. Since the inception of LS, all patients were enrolled in a prospective, longitudinal database. Perioperative parameters were assessed, including patient age and sex, surgical indication for splenectomy, need for conversion to open splenectomy, estimated blood loss, requirement for blood product transfusion, spleen specimen weight, pre- and postoperative hematocrit and platelet levels, time to oral intake, length of hospital stay, and perioperative morbidity or mortality. Additional information was obtained by direct patient interview or review of medical records when necessary.

Since the annual number of LS was relatively constant during the 10-year study period, patients were arbitrarily separated into 2 cohorts to study the effect of institutional experience on outcome. The first consecutive 55 patients (Group I) undergoing LS were compared with the subsequent 54 patients (Group II). The 2 groups were equally matched with respect to age, sex, and indication for splenectomy. Patient demographics are detailed in **Table 1**.

Preoperative preparation was individualized. All patients received polyvalent *Streptococcus pneumoniae* vaccination before surgery. Some patients also received vaccination against *Hemophilus influenzae*. Transfusion of blood products, such as platelets, packed red blood cells, or gamma globulin, was performed at the discretion of the referring hematologist, attending surgeon, or anesthesiologist. Routine preoperative imaging to determine splenic size or the presence of accessory splenic tissue was not performed. Preoperative angiographic embolization was not used in any patient during the study.

The operative technique of LS evolved over the 10-year period. The procedure was performed with the patient in the supine position in the first 27 patients, the so-called "anterior approach."[6] Gradual adoption of the lateral approach to LS occurred due to the institution's large and successful experience with laparoscopic donor nephrectomy. The lateral approach to LS has been used exclusively for the past 7 years.

Briefly, the patient is positioned in the right decubitus position. Care is taken to ensure proper support and padding of the patient's head, neck, and lower extremities. Both the operating surgeon and camera operator stand on the right side of the operating table. Three or 4 operating ports are placed after a pneumoperitoneum is created **(Figure 1)**. The initial 5-mm port (A) is placed lateral to the rectus sheath approximately 1 cm to 2 cm above the umbilicus. Port B (5 mm) is placed immediately below the left costal margin in the midclavicular line, and port C (15 mm) is placed 8 cm to 10 cm below the left costal margin in the anterior axillary line. An additional port (D, 5 mm) is often used to aid with retraction of the splenic hilum or suctioning the operative field in cases when significant splenomegaly is present. A 5-mm, 30-degree, angled laparoscope is placed into port B, and the operating surgeons left- and right-handed instruments are inserted through port A and port C, respectively. The operative dissection is determined to some extent by the size, configuration, and consistency of the spleen, as well as the indication for splenectomy. The first step is usually a thorough search for accessory splenic tissue, focused on the hilum, omentum, and lesser sac. Dissection generally begins with division of the splenocolic attachments and dissection of the medial aspect of the spleen in a cephalad direction. The inferior pole splenic vessels are clipped or divided with an ultrasonic scalpel. Blunt dissection on the anterior and posterior aspects of the hilum is undertaken to the extent the anatomy will allow. The hilar structures, including the splenic artery and vein are ligated *en masse* with an endoscopic linear stapler. The gastrosplenic ligament and short gastric vessels are then divided using either an ultrasonic scalpel or endoscopic linear stapler. Finally, the lateral attachments of the spleen are divided, and the spleen is placed into a large specimen retrieval sac inserted through the 15-mm port. Extraction of the spleen from the abdominal cavity is facilitated by use of a ringed forceps or other clamp to fracture and morcellate the specimen after the retrieval sac is partially exteriorized.

Table 1.
Patient Demographics

	Group I	Group II
Mean Age (years)	38 (6–79)*	44 (12–77)*
Male	24 (44%)	27 (50%)
Female	31 (56%)	27 (50%)
Benign Pathology	40 (73%)	30 (56%)
Malignant Pathology	15 (27%)	24 (44%)

*Range given in parentheses.

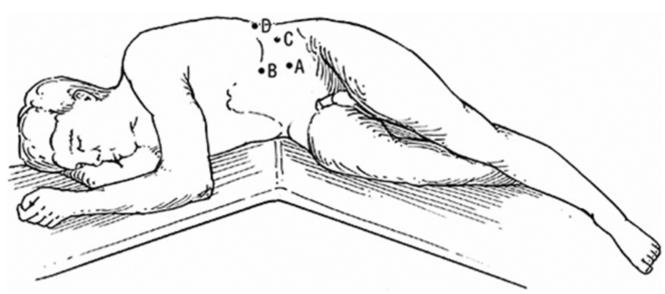

Figure 1. Patient positioning and typical port placement for the lateral approach. Port A, Port B, and Port D (when necessary) are 5-mm ports, and Port C (used for specimen extraction) is a 15-mm port. (Reprinted with permission from the *Archives of Surgery* 1999;134:1263–1269, Copyrighted 1999, American Medical Association)

Occasionally, it is necessary to enlarge the 15-mm skin excision.

Postoperatively, patients are monitored for pain control, ability to resume oral intake, and the occurrence of complications. The hematologic response to splenectomy is also monitored, though it is usually too soon to determine whether a positive therapeutic response to splenectomy has occurred by the time of discharge. Patients are discharged when they are fully able to tolerate a liquid diet and their pain is adequately controlled with oral analgesics. All patients are followed in the surgeon's office 10 days to 14 days after discharge.

RESULTS

From March 1992 to November 2001, LS was performed in 109 consecutive, unselected patients with benign or malignant hematological diseases. The indications for splenectomy are listed in **Table 2**. Laparoscopic splenectomy was successfully performed in 48 of 55 patients (87%) in Group I and 53 of 54 patients (98%) in Group II. Conversion to open splenectomy **(Figure 2)** occurred in 7of 55 patients (13%) in Group I and 1 of 54 patients (2%) in Group II (P=0.03). Excessive bleeding was the indication for conversion of 6/7 patients in Group I and the single conversion in Group II. An additional patient in Group I with Hodgkin's disease undergoing a staging procedure required conversion to laparotomy. The laparoscopic procedure was converted to an open procedure to better facilitate mesenteric and periaortic lymph node dissection.

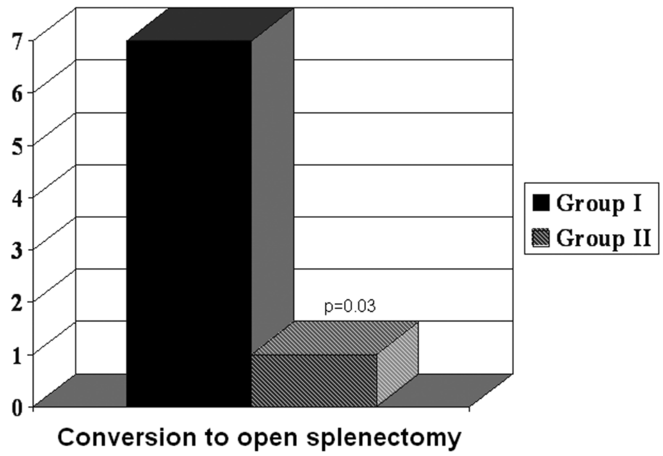

Figure 2. The need for conversion of laparoscopic splenectomy to open splenectomy has decreased with experience.

Perioperative data are expressed in **Table 3**. Although the mean operative time did not decrease over the years, operative blood loss significantly decreased in patients in Group I compared with those in Group II (P=0.015). Splenic specimen weight significantly increased over the last decade. Mean specimen weight was 288±44 g in Group I and 512±74 g in Group II (P=0.03). No significant difference existed between Groups I and II with respect to time to resumption of oral intake or length of hospital stay.

Postoperative morbidity was 13% in Group I and 9% in Group II **(Table 4)**. Perioperative arrhythmia necessitating intensive care unit monitoring occurred in 4 patients (2 from each group). Additional complications included left lower lobe pneumonia (2 patients), superficial wound

Table 2.
Indication for Laparoscopic Splenectomy

Cause*	Number	Percentage
ITP	41	38
Hodgkin's disease	12	11
Hypersplenism/Splenomegaly	12	11
AHA	9	8
CLL	8	7
CML	7	6
Lymphoma (other)	7	6
Splenic abscess	4	4
Splenic cyst	4	4
TTP	3	3
Metastatic melanoma	1	1
Hemangioma	1	1

*ITP=idiopathic thrombocytopenic purpura, AHA=autoimmune hemolytic anemia, CLL=chronic lymphocytic lymphoma, CML=chronic myeloid leukemia, TTP=thrombotic thrombocytopenic purpura.

Table 3.
Perioperative Data*

	Group I (n=55)	Group II (n=54)	*P*
Operating Room Time (min)	151±7	159±12	NS
Blood Loss (mL)	544±73	308±60	0.015
Spleen Weight (g)	288±44	512±74	0.03
Time to Intake by Mouth (h)	25±2.5	24.2±2.6	NS
Length of Stay (h)	107±33	94.9±24	NS

*Results expressed as mean±standard error of mean.

Table 4.
Complications After Laparoscopic Splenectomy

Group I*	Group II*
Postoperative arrhythmia (2)	Postoperative arrhythmia (2)
Wound infection	Wound infection
LLL pneumonia	LLL pneumonia
Subphrenic abscess	Abdominal wall hematoma
Ileus	
Death (OPSI)	

*LLL=left lower lobe, OPSI=overwhelming postsplenectomy infection.

infection at the extraction site (2 patients), ileus (defined as no return of bowel function for >48 hours after surgery), subphrenic abscess, and an abdominal wall hematoma at the extraction site. No significant difference existed in morbidity between Groups I and II.

Mortality occurred in 1/109 patient (1%), as a result of overwhelming postsplenectomy infection (OPSI). The patient was a 33-year-old female who underwent LS in 1994 (Group I) for refractory thrombocytopenia of an uncertain cause. Her past medical history was also significant for primary pulmonary hypertension. She developed a fever approximately 48 hours after an uneventful surgical procedure. Despite empiric broad-spectrum parenteral antibiotic therapy, clinical deterioration occurred with rapid onset of anuria and refractory hypotension. She succumbed on postoperative day 8. The cause of death was *Staphylococcus aureus* sepsis from a central venous catheter introducer through which a pulmonary artery catheter was placed for intraoperative hemodynamic monitoring.

DISCUSSION

Laparoscopic splenectomy has become the gold standard for the elective treatment of many diseases of the spleen. Although several studies document the safety and efficacy of LS, no large, single-institution analysis has been performed to date. Accordingly, several interesting observations can be drawn from this study.

Most importantly, LS was performed with acceptable morbidity throughout the 10-year study period, despite the unselected nature of the series and inclusion of patients with significant comorbidities. The overall complication rate was 11% for the entire series and only 9% over the last 5 years (Group II). The nature of the complications was typical after splenectomy (wound infection, subphrenic abscess, left-sided pulmonary complications), though the incidence of arrhythmia was somewhat higher than anticipated. These data compare favorably with data from the largest series of LS published to date. Park examined 200 patients from 2 different institutions who underwent LS from 1993 through 2000. Overall morbidity was 9.3%, and no perioperative mortality occurred.[8]

The 1 death in this series deserves special attention. The patient expired after a rapid, fulminant course of gram-positive bacterial septicemia, a clinical picture very consistent with overwhelming postsplenectomy infection (OPSI). This is one of the first deaths from OPSI reported after LS. The incidence of OPSI is typically quoted as approximately 3.2%, with an overall mortality of 1.4%.[9] However, the mortality rate is as high as 17% when bacteremia occurs in an asplenic individual in the immediate postoperative period.[10] Unfortunately, current data regarding the epidemiology of OPSI were generated during the era of open splenectomy. It is not clear whether the incidence of OPSI after LS in 2003 is equal to that after open splenectomy from 1960 to 1990. Perioperative care now includes widespread preoperative polymicrobial vaccination and improved antibiotic therapy. It is also not clear whether the lesser insult to the immune system seen after laparoscopic procedures translates into any clinical benefit. Further study in this area is necessary. In any case, it is important to realize that in asplenic individuals who are immunized against *Streptococcus pneumoniae*, the likelihood of identifying this pathogen as the cause of a septic process is unlikely.[10]

Examination of intraoperative variables in this series reveals mixed results. A clear trend exists toward successful performance of LS in patients with larger spleens, lower blood loss, and acceptable morbidity. However, operative times were not significantly improved over the 10-year period. In addition, technical improvements did not seem to result in earlier discharge from the hospital or more rapid resumption of a diet. A number of possible explanations exist for these observations.

Multiple factors influence the operative times during laparoscopic splenectomy, including surgeon experience, indication for the procedure, the presence of surgical trainees, and patient factors such as the presence of coagulation defects or prior upper abdominal surgical procedures. Examination of these variables may suggest why the mean operative times did not decrease over the last decade. First, referral patterns from surrounding hematologists changed over the 10-year period. As surgeons and referring physicians gained confidence, patients with increasingly larger spleens and more complex medical conditions were seen. The number of LS performed for idiopathic thrombocytopenic purpura (where spleen size is usually normal) has dramatically decreased, whereas the number of LS performed for secondary hypersplenism and hematological malignancies has increased. Secondly, operative times in teaching institutions tend to be cyclical. During the early University of Maryland experience with LS, 2 attending surgeons routinely performed the procedure. Surgical fellows and residents enjoyed an increased level of participation once the attending faculty had mastered the technique. Though operative times are decreased by improved surgical instrumentation and attending surgeon experience, these improvements tend to be offset by increased participation of trainees. Therefore, operative times at teaching institutions are not likely to change for the next several years.

Despite the fact that specimen weight in this series increased over time, a concomitant decrease occurred in operative blood loss. Reasons for this observation are complex and include better instrumentation and operative technique, and increased surgeon experience. Data during open splenectomy suggest that spleen weight is directly proportional to blood loss.[11] Operative data for LS in patients with larger spleens is particularly interesting. The average specimen in this series weighed 512 g (normal splenic weight, 150 to 300) during the past 5 years. Several specimens weighed more than 2000 g. Despite the increased technical difficulty posed by splenomegaly, LS was accomplished in a timely fashion in these patients (mean operative time, 159 minutes), with minimal blood loss (mean blood loss, 308 mL) and only 1 conversion to open splenectomy. Kercher et al[12] recently reported similar results for LS in patients with massive splenomegaly. In their series, "massive splenomegaly" was defined as splenic weight greater than 600g. The mean operative blood loss was 114 mL, mean operative time was 171 minutes, and no conversions to laparotomy were necessary. When this same group of surgeons compared LS in patients with splenomegaly (defined as splenic weight greater than 500 g) to LS in patients with normal-sized spleens, they noted longer operative times and increased blood loss in patients with splenomegaly.[13] A higher rate of conversion did not occur in their patients with splenomegaly. However, Terrosu et al[14] noted that when LS was performed in patients with spleens larger than 2000 g, a higher rate of conversion to laparotomy, an increased amount of blood loss, and a longer hospital stay occurred compared with LS performed in patients with smaller spleens.

The declining rate of conversion of LS to open splenectomy in this series is also multifactorial. Better equipment is partially responsible by allowing less operative hemorrhage through improved hemostasis and less tissue trauma during exposure and retraction. However, the institutional learning curve is probably the most important factor. As attending surgeons gain experience with LS, their operative decision-making and level of comfort is improved. Previous studies have correlated the likelihood of conversion of LS to open splenectomy with increasing blood loss and spleen size.[15] During the first 5 years of our study, 13% of the procedures were converted to laparotomy, mostly due to excessive bleeding. However, over the past 5 years, only 1 conversion has been necessary (2%). Park[8] noted a similar institutional trend. While his overall conversion rate was 3%, over his last 160 procedures, only 1.2% was converted to open splenectomy.

CONCLUSION

These data represent a decade of experience with LS, which can be performed safely for a wide variety of indications. Over the last 10 years, the average spleen size has increased, yet a significant reduction in blood loss and conversion rate has been achieved.

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